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THE STATUS OF SCIENCE TEACHING IN THE ELEMENTARY SCHOOLS OF THE UNITED STATES

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One of the unsettled questions of the day concerns itself with the importance of science teaching in the grammar grades. There are many reasons why science should be taught in the grades, and there are but two reasons given why it cannot be taught. The latter are the crowded curriculum and the unpreparedness of the teachers, both of which may be remedied and gradually abolished.

The reasons for science in the grades fall under two heads: the personal and the economic. There is more to learn now than formerly, and the need for scientific education is becoming more pressing. Seventy-eight per cent of those who enter the grades do not go to high school, and if there is no scientific study given during these years the 78 per cent will never receive any real instruction in science. Again, science is so stimulating that its general introduction into the grades could do more toward retaining in the schools some of the 78 per cent than can any other study, and, in addition, it might arouse the ambition of some to take up a more advanced study of science.

The child cannot be aware of his need for science. The need becomes more apparent as scientific knowledge increases. It is society, however, which benefits most by the child's knowledge of science. The nature of scientific training is such that the child acquires habits of orderly and creative thinking; of reasoning from cause to effect. These habits will outlive the scientific facts which have led to their formation. Dewey has said: "We need to develop a certain active interest in truth and its allies, a certain disposition of inquiry, together with a command of the tools which make it effective, and to organize certain modes of activity in observation, construction, expression, and reflection." Science teaching may be made the study pre-eminently fitted for producing these results.

That community in which a large proportion of its citizens has had some scientific training will be well advanced economically.

In an attempt to ascertain the status of science teaching in the grades throughout the United States, a questionnaire was prepared and sent to all of the states, according to their population. Approximately one questionnaire was sent for each one hundred thousand inhabitants, or 872 in all. Of these, there were received 282 replies, making 32 per cent of returns. The list of questions follows:

1. Do you believe in science teaching in the elementary grades?
2. Should science be taught as a separate subject?
3. In what grade do you think science teaching should begin?
4. What object should be sought in the teaching of science in the grades?
5. How may this object be attained?
6. What should the science material consist of?
7. Do you think that science in the grades should lead toward the industries or toward general information and development?
8. How early should the pupils be required to make formal experiments?
9. How early should the pupils keep a formal record of their work?
10. What science or sciences does your school give in the grades?
11. What are the grades in which science is taught and what science is taught in each grade?
12. What is the method of presentation of the science in your school?
13. Do pupils tend to reason from one fact to another or is their knowledge more like a series of facts which are unrelated?
14. What interest do the boys show in the science work?
15. What interest do the girls show in the science work?
16. Does science aid in the other studies, either in time or understanding?
17. Does science work tend to keep the pupils in school longer?
18. Does science work tend to increase the number of pupils who go to high school?

Early in the work it was found necessary to reduce the number of kinds of answers, in order to draw any conclusions from the replies. Although there were but eighteen questions, soon the number of varieties of answers reached 287. By careful adjustments this number was reduced to 147, the later replies being filed under the headings which corresponded the closest with them. The information, which was received from the whole United States, is given in the form of summary tables. There is added a list showing the sources of the information.

KEY 1

Do you believe in science teaching in the grades?

Answers:

		Base 282	
		Number	Percentage
A.	Yes	234	83
B.	Yes—as nature-study	22	8
C.	Not as a definite subject—as correlation	12	5
D.	No	14	5
		282	Base

KEY 2

Should science be taught as a separate subject?

Answers:

		Base 277	
		Number	Percentage
A.	Yes	110	40
B.	Yes—as geography	8	3
C.	Yes—as nature-study	19	7
D.	Yes—as physiology and hygiene	8	3
E.	Yes—in sixth, seventh, and eighth grades	31	11
F.	Both separate and as correlation	18	6
G.	No—as correlation	82	30
H.	Not with a text	1	..
		277	Base

KEY 3

In what grade should science teaching begin?

Answers:

		Base 264	
		Number	Percentage
A.	Kindergarten—as nature-study	18	7
B.	First grade	117	44
C.	First grade—as nature-study	20	8
D.	Third or fourth grade	40	15
E.	Fifth grade	23	9
F.	Sixth grade	17	6
G.	Seventh grade	22	9
H.	High school	7	3
		264	Base

KEY 4

What object should be sought in this science teaching?

Answers:

		Base 406 Number	Percentage
A.	Information concerning common things and phenomena. Laws	107	26
B.	Observation and explanation of phenomena, training in observation	99	24
C.	Broadening of interests	52	13
D.	Habits of thought, reasoning power, scientific spirit, exactness	57	14
E.	Appreciation and love of nature	38	9
F.	The place of self in the environment	17	4
G.	Practical knowledge	19	5
H.	Preparation for high school or for future work	9	2
I.	Culture	8	2
		406	Base

KEY 5

How may this object be attained?

Answers:

		Base 262 Number	Percentage
A.	Good teaching—teach the child *as* a child—good syllabus	91	35
B.	By experiments by the pupils—real objects.	60	23
C.	Observation *and* application—assembling facts, explanations; clear and accurate statements	47	18
D.	Observing *living* animals and plants with *guidance*	28	11
E.	By selecting general informational subjects	12	5
F.	By excursions, visits to manufacturing plants, etc	13	5
G.	By readings and lantern lessons	6	2
H.	Textbook in the hands of pupils	5	2
		262	Base

KEY 6

What should the science material consist of?

Answers:

		Base 247	
		Number	Percentage
A.	Phenomena of the environment	124	50
B.	Objects, specimens, especially alive, pictures, simple apparatus	30	12
C.	Nature-study—elementary science in the seventh and eighth grades	40	16
D.	*All* sciences	19	8
E.	Products of man's work—industries	9	4
F.	The relations of self to the rest of the world	7	3
G.	The use of textbooks	5	2
H.	Good teaching and much laboratory work	10	4
I.	Agriculture, physiology, biology, gardens	3	1
		247	Base

KEY 7

Should science lead toward industries or general information and development?

Answers:

		Base 260	
		Number	Percentage
A.	General information and development	147	57
B.	Industries	12	5
C.	Industries in upper grades	11	4
D.	Both	70	27
E.	Both—emphasis on industries	10	4
F.	Both—emphasis on general information	10	4
		260	Base

KEY 8

How early should pupils make formal experiments?

Answers:

		Base 240	
		Number	Percentage
A.	At the beginning of science work	29	12
B.	No time can be set	16	7
C.	First grade	20	8
D.	Third grade	13	5
E.	Fourth grade	14	6
F.	Fifth grade	18	8
G.	Sixth grade	26	11
H.	Seventh grade	57	23
I.	Eighth grade	19	8
J.	High school	28	12
		240	Base

KEY 9

How early should pupils keep a formal record of experiments?

Answers:

		Base 236 Number	Percentage
A.	From the beginning of science work	42	18
B.	No time can be set	12	5
C.	First grade	4	2
D.	Third grade	17	7
E.	Fourth grade	14	6
F.	Fifth grade	18	8
G.	Sixth grade	23	10
H.	Seventh grade	53	22
I.	Eighth grade	21	9
J.	High school	32	14
		236	Base

KEY 10

What sciences does your school teach?

Answers:

		Base 401 Number	Percentage
A.	Agriculture	30	7
B.	Biology	11	3
C.	Botany	18	4
D.	Elementary science (physics and chemistry)	38	9
E.	General science	61	15
F.	Geography	40	10
G.	Hygiene (sanitation)	21	5
H.	Incidental	7	2
I.	Meteorology	5	1
J.	Nature-study	79	20
K.	None, or very little	25	6
L.	Physiology	66	16
		401	Base

KEY 11

In what grades are the different sciences taught, or is the work general?

Answers:

		Base 270	
		Number	Percentage
A.	Nature-study in all grades	47	17
B.	Nature-study in lower grades	21	8
C.	General science in all grades	61	23
D.	General science in lower grades	10	4
E.	General science in eighth grade	7	3
F.	Physics in upper grades	25	9
G.	Physiology in all grades (hygiene and sanitation)	25	9
H.	Physiology in fourth to eighth grades	25	9
I.	Geography in all grades	9	3
J.	Geography in fourth to eighth grades	9	3
K.	Incidental	7	3
L.	Agriculture in fourth to eighth grades	24	9
		270	Base

KEY 12

What is the method of presentation of science in your school?

Answers:

		Base 214	
		Number	Percentage
A.	Experiments by teacher *and* pupils	62	28
B.	Experiments by teacher, observation and record by pupils	17	8
C.	Object method	37	17
D.	Observation and deduction	14	6
E.	Oral—inductive	31	14
F.	By book and experiment	27	12
G.	Talks, grades 1–3; text, grades 4–8	6	3
H.	Various methods; depends upon the teacher	20	9
		214	Base

KEY 13

Do pupils reason or is their learning a series of facts?

Answers:

		Base 191	
		Number	Percentage
A.	Series of facts	71	37
B.	Progressive reasoning	43	22
C.	Both	10	5
D.	They learn to relate slowly	31	16
E.	Try to teach reasoning	16	8
F.	It depends upon the teaching	14	7
G.	Not prepared to answer	6	3
		191	Base

KEY 14

What interest do boys show in the science work?

Answers:

		Base 179	
		Number	Percentag
A.	Excellent	41	23
B.	Good	60	33
C.	Experimental work liked best—the doing	26	15
D.	More than in any other subject	6	3
E.	Same as in any other study	21	12
F.	More than the girls	13	8
G.	Everything depends upon the teacher	12	7
		179	Base

KEY 15

What interest do girls show in the science work?

Answers:

		Base 177	
		Number	Percentage
A.	Excellent	20	11
B.	Good	18	10
C.	Good in adapted work	21	12
D.	More than the boys	3	2
E.	As much as the boys	68	39
F.	Hardly less than the boys	9	5
G.	Less than the boys	29	16
H.	More *lively*—less real interest than the boys	4	2
I.	Same as in any other subject	5	3
		177	Base

KEY 16

Does science aid the other studies in time or in understanding?

Answers:

		Base 198	
		Number	Percentage
A.	Yes, in one or the other	102	52
B.	Both	31	16
C.	Understanding	15	8
D.	Yes, in geography	7	4
E.	Yes, especially for oral and written expression	6	3
F.	Somewhat, in one or the other	7	4
G.	Like other studies if well taught	9	5
H.	No	6	3
I.	Hard to tell	15	8
		198	Base

KEY 17

Does science tend to keep pupils in school longer?

Answers:

		Base 195	
		Number	Percentage
A.	Yes	73	37
B.	Probably—I think so—I believe so	26	13
C.	Think not	12	6
D.	Not to a marked degree (like other subjects)	18	9
E.	No	15	8
F.	Don't know—can't tell—hard to tell	51	26
		195	Base

KEY 18

Does science work increase number of pupils going to high school?

Answers:

		Base 194	
		Number	Percentage
A.	Yes	76	39
B.	Probably—I think so—I believe so	29	15
C.	True of any subject well taught	7	4
D.	No	23	12
E.	Don't know—no evidence—hard to tell	59	30
		194	Base

There can be no doubt that educators believe that science should have a place in the curriculum of the grades. While 83 per cent of the replies are unqualifiedly in favor of science teaching, 8 per cent limit science teaching to nature-study and 4 per cent believe that it should be given as correlation. A small minority, 5 per cent, are decidedly opposed to science teaching in the grades, and their opposition is based upon the fact that the curriculum is already too crowded and that teachers are not prepared to take up science teaching.

That science should be taught as a separate subject is believed by 40 per cent; that it should be geography by 3 per cent, nature-study by 7 per cent, physiology and hygiene by 3 per cent, and that it should be taught only in the upper grades by 11 per cent. This makes a total of 64 per cent who are in favor of science as a separate subject. It will be noticed that 30 per cent are in favor of science

DISTRIBUTION OF QUESTIONNAIRES AND REPLIES

Number	State	Number Sent	Number Received	Percentage Received	Number Normals	Percentage Normals
1	Alabama	24	7	28	0	0
2	Arizona	6	1	17	1	100
3	Arkansas	14	3	21	0	0
4	California	59	26	44	4	15
5	Colorado	9	2	22	1	50
6	Connecticut	10	5	50	2	40
7	Delaware	3	0	0	0	0
8	Dist. of Columbia	10	4	40	1	25
9	Florida	5	1	20	0	0
10	Georgia	13	3	23	0	0
11	Idaho	4	1	25	1	100
12	Illinois	62	23	37	5	21
13	Indiana	33	12	36	0	0
14	Iowa	19	7	39	1	14
15	Kansas	13	5	38	2	40
16	Kentucky	18	6	33	2	23
17	Louisiana	9	5	55	2	40
18	Maine	9	3	33	2	66
19	Maryland	5	0	0	0	0
20	Massachusetts	35	10	29	2	20
21	Michigan	29	10	34	0	0
22	Minnesota	24	5	21	2	40
23	Mississippi	14	1	7	0	0
24	Missouri	22	7	32	0	0
25	Montana	6	1	17	0	0
26	Nebraska	16	6	37	2	33
27	Nevada	3	2	67	2	100
28	New Hampshire	4	4	100	1	25
29	New Jersey	27	11	41	2	18
30	New Mexico	6	2	33	1	50
31	New York	64	18	28	2	11
32	North Carolina	7	1	14	0	0
33	North Dakota	9	1	11	1	100
34	Ohio	62	21	34	2	10
35	Oklahoma	8	2	25	1	50
36	Oregon	7	1	14	0	0
37	Pennsylvania	50	18	36	3	17
38	Rhode Island	5	2	40	0	0
39	South Carolina	7	2	29	1	50
40	South Dakota	9	5	55	2	40
41	Tennessee	14	3	21	0	0
42	Texas	29	4	14	2	50
43	Utah	5	3	60	0	0
44	Vermont	4	2	50	1	50
45	Virginia	14	1	7	0	0
46	Washington	16	7	44	1	14
47	West Virginia	11	4	36	2	50
48	Wisconsin	35	12	34	4	33
49	Wyoming	5	1	20	0	0
	Totals for United States	872	282	32	58	21

teaching as correlation, although in Question 1 only 4 per cent so indicated their belief. This is probably due to the division of their replies and 30 per cent may be taken as the correct percentage of teachers who believe in correlation of science work. Be this as it may, a large majority of teachers are in favor of science as a separate subject in the grades. The crowded condition of the curriculum does not seem to prevent the introduction of science as a new subject.

The grade in which science teaching should begin is undoubtedly the first, 52 per cent so believing. Of these 8 per cent would limit the science to nature-study. A second maximum is reached in the third or fourth grade with 15 per cent. It is quite apparent that the majority of teachers believe that there should be instruction in science throughout the entire grammar-school course. A small percentage believe that it should begin, as nature-study, even in the kindergarten.

The object of science teaching in the grades would seem to be information concerning common things, a proper observation of them, and a reasonable explanation for their occurrence. Those in favor of information concerning everyday phenomena number 26 per cent, while 24 per cent believe that training in observation and the explanation of phenomena are the desired objects. Broadening of interests, as an object to be sought in science teaching, is indicated by 13 per cent, and reasoning power, as a goal, is stated by 14 per cent of the replies. Practical knowledge, as a desired aim of science teaching, wins the support of but 5 per cent. This seems odd in this age of utilitarianism, and will be taken up again in Question 7.

Though rather decided that science should be taught so as to give information and to develop powers of observation, there is not much information given in regard to methods of obtaining this result. Good teaching as a method is given by 35 per cent, but all educators are in favor of good teaching. The question is, What is good teaching in science? It must be different from the usual methods of teaching in the other subjects of the grades. The answer that the object of science teaching may be attained by observation *and* application, by assembling facts, and giving explanations in clear and accurate statements, while receiving but 18 per cent of the replies in its favor, is probably the truest solution. Experiments by the pupils, excursions, and readings, in fact all of the devices of teachers of science, are of little value without the use of this method. Mere observation is useless unless it can be fixed by the concrete example, by many concrete examples. The acquisition of facts is incomplete unless they can be grouped according to the child's idea, to be sure, around some central fact, while clear and accurate statements of fact are the only evidences of real knowledge. Unless a child can explain phenomena, he does not know their reason for existing. There is too much learning of word formulas and too little learning of ideas. Good teaching *is* necessary, but good teaching can be given only by good teachers.

As science material, the phenomena of the environment leads with an even 50 per cent. This is as it should be. Our knowledge, especially when we are young, should be concerned with a good understanding of our immediate surroundings. Later the sphere of knowledge may be enlarged, and that sphere is the most stable which has the solidest core. Closely connected with the environment, objects and specimens as science material meet the favor of 12 per cent. Nature-study and elementary science meet the approval of 16 per cent, while 8 per cent believe that all of the sciences should contribute material for a science course in the grades. As a source of material, 4 per cent mention the industries. The fact that only 1 per cent believe in agriculture and garden work is the most surprising answer of all.

There seems to be much indefiniteness in regard to the content of nature-study. Naturally a complete study of nature must embrace nearly all scientific knowledge. The definition that nature-study is limited to plants and animals seems best. If that is accepted there need be no doubt as to the material which is to be studied. To study the phenomena of the environment in a satisfactory manner necessitates the introduction of material from all of the sciences. Note that this is not the same as saying that it is necessary to teach all of the sciences in the grades. The different sciences are but artificial, man-made divisions of phenomena, and in the grades—if not also in the high school—the phenomena should be studied irrespective of the sciences of which the scientist deems that they are a part. Such a collection of everyday, useful phenomena may well be given the name of general science.

The question whether science teaching in the grades should lead toward general information and development or toward the industries is answered in favor of the former by 57 per cent, while but 5 per cent lean toward the industries. That both should be the goal of science teaching is believed by 27 per cent. These replies must cause some surprise in this so-called commercial age. It was noted in Question 4 that practical knowledge as an object of science teaching is favored by but 5 per cent. It is interesting to see that 5 per cent also believe in the industries. It is still more interesting to discover, by reference to the original replies, that only one individual who believes in practical knowledge is found among those who believe in the industries. We must conclude that by practical knowledge is meant, not money-making ability, but real mental development which shall be lasting and beneficial to its possessor and also to the community. There is no reason why general information and development may not produce the most practical education possible. The poorest preparation for a given occupation is the one which ignores the interrelations of all lines of work, and concerns itself with but the one. Just as the rays of light diverge from their source, so must the lines of thought spread out and envelop all things, until the lens of specialization brings to a focus those lines of thought which are strongest and clearest. Woe be to him who holds his lens too close to the source.

The place where formal experiments should be performed seems to be in the seventh grade, 23 per cent so indicating their belief. This percentage is small, due to the fact that each grade has its advocates. That formal experiments belong in the high school is indicated by 12 per cent. In both Questions 8 and 9 there seems to be considerable misunderstanding in regard to the word "formal." "Formal experiments" and "formal records" were intended to mean experiments and records having definite or regular form, but both being adjusted to the capacity of the child and therefore natural. It is possible that it was this misinterpretation of the question which led to such diverse answers.

The seventh grade also leads with 22 per cent as the place where formal records of experiments should be kept. While in Question 8, 12 per cent believe that formal experiments should be made at the beginning of science work, in Question 9, 18 per cent believe that formal records should be kept from the beginning. This is explained when it is noticed in Question 12 that many experiments are performed by the teacher while the pupils make the record. Thus the records by the pupils may easily precede the performance of experiments by them.

The answers to Questions 8 and 9 strongly indicate that there is a decided break in the grades between the sixth and seventh years. Some of the other answers also point this same way, and there can be no doubt that the introductory high school, or, as it is also called, the intermediate high school, is based upon correct principles. If science is taught in no other grades, it surely should be part of the curriculum of the seventh and eighth grades, and its nature should be broad and general.

The answers to Question 10 are greater in number than the number of questionnaires which were returned because many of the replies gave two or more different sciences. A comparison of the popularity of the various sciences is nevertheless possible. Nature-study still leads, receiving 20 per cent, but it is on the decrease, due to a growing dissatisfaction because it does not seem to meet the requirements of the child. There are so many other things which he wishes to know in science that information concerning plants and animals, although desirable, is not sufficient. Physiology comes next to nature-study with 16 per cent, while general science is a close third with 15 per cent. If, however, elementary science is taken to be the same as general science, then the latter leads all, having 24 per cent. When we remember that, in the replies to Question 6, 50 per cent are in favor of phenomena of the environment as a source of science material, and when we consider that these phenomena must of necessity be the manifestations of all of the sciences, it seems quite evident that general science is the coming study for the grades.

Referring again to the answers of Question 6, it is seen that only 1 per cent believe that the science material should be drawn from agriculture, physiology, biology, and garden work, while in the replies to Question 10, 7 per cent state that they are teaching agriculture, 3 per cent biology, 4 per cent botany, and 16 per cent physiology, making a total of 30 per cent. The natural conclusion is that 29 per cent are teaching these studies, although they do not believe that they are the best sources of science material. This conclusion is a little offset by the fact that a larger percentage of city schools than country schools replied. This doubtless explains why only 7 per cent of the schools from which replies were received are teaching agriculture. Even if this is the reason, it seems strange that such an important subject is not gaining ground faster in the elementary schools, since it is winning such a strong hold upon the high schools of this country. It may be that it is a study which is too highly specialized for the grades.

Although required and taught in most schools, geography receives in its favor but 10 per cent of the answers. Probably most teachers do not consider geography as a science. The smallness of the number of schools in which no science is taught, namely 6 per cent, is a good sign and strengthens the replies to Question 1.

The answers to Question 11 show that elementary science and general science were considered as being the same. Grouping answer A with answer B, and combining answers C, D, and E, general science has 30 per cent in its favor and nature-study has 25 per cent. Comparing answer A with answer C, it is seen that general science leads nature-study *in all the grades* in the ratio of 23 to 17. The variations in the percentages of the replies to Questions 10 and 11 are due to the different number of answers. While 401 replies were given for Question 10, only 270 replies were received for Question 11. It might not be out of place to suggest that in the comparison of the answers to different questions the number replying should be noted as well as the percentage.

As a method of presentation of science in the grades, experiments by teacher *and* pupils leads with 28 per cent, while the object method, which is doubtless the same as the experimental method, comes next with 17 per cent. It is quite evident that science, even in the grades, has outgrown the memoriter method. However, as many of the replies suggested, the experiments to be performed by the pupils should be simple, and those which do not require exact measurements or much detail work. The experiments should direct the child's *activity* and not tend to cramp him in his quest for scientific knowledge. Better a few self-discovered facts that live and have a meaning than many teacher-imposed "facts" which are but word formulas, and affect the child but little.

That the knowledge which the pupils of the grades acquire is a series of more or less unrelated facts is indicated by 37 per cent of those who replied. Besides these, 16 per cent believe that children only slowly learn to relate a new fact with facts previously known. On the other hand, 22 per cent think that such pupils possess progressive reasoning power. The 7 per cent who believe that the results depend upon the teacher, and the 8 per cent who state that reasoning power should be taught as far as possible, while not directly answering the question, do point the way to better things. Reasoning power can be developed in no way better than by means of science work, or through the application of scientific methods to the other work of the grades. Since science teaching has not been given in the grades long enough for the other subjects to be affected by its methods, it should be given a more important place in the curriculum, not alone for its own sake but in order that it may exert an energizing influence upon the whole course of study. All lines of study should encourage the child's What? How? and Why? to the fullest extent—and then satisfy him with ideas, not give him words as empty as sounding brass.

The answers to Questions 14 and 15 show that the interest in science work in the grades is very good. Only 12 per cent believe that science work attracts no more interest than the other studies. The evidence that boys show more interest in science than is shown by girls is not very strong, although 16 per cent so state, since 39 per cent believe that girls show as much interest as the boys. It is doubtful if there is much differentiation in educational interest before the high-school age.

The evidence that science aids the other studies both in time and in understanding is decidedly conclusive. Combining the first six replies, it is seen that 87 per cent consider that its effect upon the other studies is very beneficial. In comparison with this, the 3 per cent who think that science does not aid the other studies seem to be in the hopeless minority. In justice to them, as well as to the 8 per cent who found it a hard question to answer, it must be said that several stated that if the science teaching in their schools could be improved it would aid the other studies. This again brings up the matter of better prepared teachers who can teach science.

The answers to Questions 17 and 18 must prove of great interest to all educators. If 50 per cent believe that science work in the grades tends to keep the pupils from leaving school, and if 54 per cent believe that it tends to increase the number of pupils who go to high school, then surely every grammar school should give a course in science. Pupils leave school more because they cannot see the good of the education which they are receiving than for any other reason. Science seems to show them that there is some advantage in attending school. Then again there is so much repetition of the work in the grades, so much of the overworked "spiral" method (with the distance between the convolutions almost microscopic), that active children rebel and break away. It may truthfully be said that much repetition is necessary in order that the facts may be fixed in the minds of the pupils, but that is because there is very little interest in the work and their minds are not in a condition to assimilate new thoughts. Give them work in science, and, if the replies to Questions 16, 17, and 18 are true, there will be the greatest of interest, the other studies will be learned in far less time, and a larger and growing percentage of pupils will graduate from the grades and go to high school.

The crowded condition of the curriculum of the grades has been mentioned many times in the replies to this questionnaire. It is usually offered as a reason why new subjects should not be added. The crowded condition of the curriculum is due more to repetition and to the method of teaching which exalts the *tools* of education to the dignity of *subjects*, than to the number of subjects which are being taught. The introduction of general science can furnish the basis for the employment of all of the tools of education. English composition, writing, spelling, oral expression, arithmetic, all would have in the minds of the pupils an excuse for existing. These studies would develop and have a truer significance, through their active use, than would otherwise be possible. Education is drudgery only to one who does not understand whither it is leading.

To teach such a science course would not be difficult to the teacher who has received instruction in general science, as defined elsewhere in this article. When the immense value of science in the grades is considered, the desirability and even the necessity for giving teachers such training is very apparent. The average teacher in the grades is not prepared to teach such a course in science. This is natural and not to the discredit of the teacher. There has been no special demand for science teaching in the grades, and the teacher who has prepared herself to teach science is teaching in the high school. The teaching of a general science course in the grades requires a different training than is necessary for the teacher of some specialized science course in the high school. Without a doubt the latter would fail completely as a teacher of science in the grades. As far as is known there is practically no instruction being given in the normal schools of the country whereby teachers may be prepared for science work in the grades, with the exception of nature-study and agriculture.

While nature-study has its place, and instruction in agriculture is certainly most desirable in the grades, these studies are naturally self-limited and do not supply the needs of the child in this pre-eminently scientific age. General science, which embraces both nature-study and agriculture, as well as including material from all of the sciences, not only supplies the needs of the child but, by showing him undreamed-of possibilities, stimulates him to higher and better things. Instruction in general science, and in the methods of teaching general science in the grades, should be given in every normal school of the United States.